

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-268891

(43)Date of publication of application : 29. 09. 2000

(51) Int. Cl.

H01M 14/00

H01L 31/04

(21)Application number : 11-074845 (71)Applicant : TOSHIBA CORP

(22)Date of filing : 19. 03. 1999 (72)Inventor : SAKURAI MASATOSHI
NAITO KATSUYUKI
HORIGUCHI AKIHIRO
SUMINO HIROYASU
YONEZU MAKI

(54) MULTI-COLOR PIGMENT SENSITIZING TRANSPARENT SEMICONDUCTOR
ELECTRODE MEMBER AND ITS MANUFACTUREMULTI-COLOR PIGMENT SENSITIZATION
TYPE SOLAR BATTERYAND DISPLAY ELEMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a solar battery of pigment sensitizing type in which a plurality of colors are arranged in a plurality of parts of a display elementsign boardetc.

SOLUTION: This solar battery comprises a first transparent electrode 101a transparent semiconductor layer 102 provided on the first electrode 101a sensitizing pigment adsorption part for a plurality of colors adsorped in a plurality of parts on the surface of the semiconductor layer 102a carrier movement layer 107 provided on the pigment adsorption partand a second transparent electrode 108 provided on the carrier movement layer 107.

CLAIMS

[Claim(s)]

[Claim 1]A multicolor dye sensitizing transparent semiconductor electrode member comprising:

A transparent semiconductor layer.

A sensitizing dye adsorption part of a plural color which stuck to two or more parts on said surface of a transparent semiconductor layer.

[Claim 2]The multicolor dye sensitizing transparent semiconductor electrode member according to claim 1wherein two or more color arrangement of said sensitizing dye adsorption part is regularly carried out to said transparent semiconductor layer.

[Claim 3]A multicolor dye sensitizing type solar cell comprising:
The 1st transparent electrode.

A transparent semiconductor layer provided on said 1st transparent electrode.

A sensitizing dye adsorption part of a plural color which stuck to two or more parts on said surface of a transparent semiconductor layer.

The 2nd transparent electrode provided on the career moving bed provided on said sensitizing dye adsorption partand said career moving bed.

[Claim 4]The multicolor dye sensitizing type solar cell according to claim 3wherein two or more color arrangement of said sensitizing dye adsorption part is regularly carried out to said transparent semiconductor layer.

[Claim 5]The multicolor dye sensitizing type solar cell according to claim 3 or 4 characterized by one surface of said 1st transparent electrode and said 2nd transparent electrodeor providing an auxiliary electrode at least into [one] said 1st transparent electrode and said 2nd transparent electrode at least.

[Claim 6]A display devicewherein the multicolor dye sensitizing type solar cell according to claim 4 is a light filter.

[Claim 7]The display device according to claim 6wherein said display device is a high-reflective-liquid-crystal display device.

[Claim 8]A manufacturing method of a multicolor dye sensitizing transparent semiconductor electrode member characterized by comprising the following.

A process of forming a transparent semiconductor on a transparent electrode.

A process which makes sensitizing dye of a plural color stick to two or more parts of said transparent semiconductor surface.

A process of being desorbed from said sensitizing dye of a specific portion of said transparent semiconductor surface by irradiating with ultraviolet rays.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the manufacturing method of a multicolor dye sensitizing transparent semiconductor electrode member, a multicolor dye sensitizing type solar cell, a display device, and a multicolor dye sensitizing transparent semiconductor electrode member.

[0002]

[Description of the Prior Art] The electric power which drives the display device used for various uses now is supplied by the liquid crystal display element, for example by the cell formed in the exterior of the liquid crystal display element.

That driving time is restricted by a battery life poses a problem. In order to lengthen driving time, use of a solar cell is effective, but in using a solar cell, there is the necessity of providing the light sensing portion of a solar cell in the exterior of a display device, and there is a problem that a display device becomes large.

[0003] In order to prevent a display device becoming large, the method of creating a solar cell is also in the inside of a display device. For example, there is a method of using opaque solar cells, such as Si, for the shade part of a liquid crystal display element so that it may be indicated to the patent No. 2728041, but the shade part cannot secure a large acceptance surface product, but sufficient energy supply is difficult. Or there is also a method of making the light absorption layer of a liquid crystal display element drive this as an energy source using an opaque solar cell so that it may be indicated to JP8-152620A, but since a light absorption layer is under a liquid crystal layer, light is interrupted by the liquid crystal layer and energy supply also with this sufficient is difficult.

[0004] In addition, methods of producing a solar cell inside a display device also include the method of forming the solar cell of a light transmittance state in the display device surface. As a solar cell which has a function which penetrates light, there are a rear-face transparent electrode solar cell which formed the amorphous-silicon solar cell on the glass substrate, a see-through solar cell, a dye sensitizing type solar cell which enable the penetration of light by opening micropore in silicon, etc. Since a color is restricted to the band gap of silicon as for a rear electrode solar cell, it will become impossible, however, for

bluegreenetc. to express a display devicefor example except red. Since a see-through solar cell makes a light transmittance state possible by microporeit both cannot take the high transmissivity and energy supply of light.

[0005]A dye sensitizing type solar cell consists of the 1st transparent electrode, the transparent semiconductor formed on it, the sensitizing dye which is stuck to the transparent semiconductor surface, a carrier layer on it, and the 2nd transparent electrode on a carrier layer as indicated for example to the patent No. 2664194. This dye sensitizing type solar cell operates through the following processes.

[0006]If the light which entered reaches sensitizing dye through sensitizing dye or the 2nd transparent electrode and a carrier layer through the 1st transparent electrode and a transparent semiconductor, light excites this sensitizing dye and an electron will be produced on a LUMO level and it will produce a hole on a HOMO level. The electron of the LUMO level of the sensitizing dye produced by excitation moves to the conducting zone of a transparent semiconductor promptly and is crossed to the 1st transparent electrode. The hole which remained in the HOMO level of sensitizing dye receives an electron from the carrier moving bed and sensitizing dye is neutralized. By having passed the electron, the ion or hole produced in the carrier moving bed diffuses the inside of the carrier moving bed, reaches the 2nd transparent electrode and receives an electron from the 2nd transparent electrode. It operates as a dye sensitizing type solar cell by using as an anode the 2nd transparent electrode that passed the negative electrode and the electron for the 1st transparent electrode that received the electron.

[0007]

[Problem(s) to be Solved by the Invention]However, in the conventional dye sensitizing type solar cells, since the number of coloring matter was one, to one transparent semiconductor, appearance had the shape of colored glass of one sheet like the rear-face transparent electrode solar cell. Therefore, since two or more colors cannot be expressed, it cannot provide in the inside of a display and does not think other than the use only as a solar cell which absorbs and generates light.

[0008]

[Means for Solving the Problem]Then, a multicolor dye sensitizing transparent semiconductor electrode member, wherein this invention comprises a transparent semiconductor layer and a sensitizing dye adsorption part of a plural color which is stuck to two or more parts on the surface of a transparent semiconductor layer is provided.

[0009]Two or more color arrangement of the sensitizing dye adsorption

part of this multicolor dye sensitizing transparent semiconductor electrode member may be regularly carried out to a transparent semiconductor layer. A transparent semiconductor layer by which this invention was provided on the 1st transparent electrode and the 1st transparent electrodeA multicolor dye sensitizing type solar cell comprising a sensitizing dye adsorption part of a plural color which stuck to two or more parts on the surface of a transparent semiconductor layerthe career moving bed provided on a sensitizing dye adsorption partand the 2nd transparent electrode provided on the career moving bed is provided.

[0010]Two or more color arrangement of the sensitizing dye adsorption part of this multicolor dye sensitizing type solar cell may be regularly carried out to a transparent semiconductor layer. moreover -- this multicolor dye sensitizing type solar cell -- at least -- one surface of the 1st transparent electrode and the 2nd transparent electrode -- or an auxiliary electrode may be provided into [one] the 1st transparent electrode and the 2nd transparent electrode at least.

[0011]Furthermorethis invention provides a display device in which these multicolor dye sensitizing type solar cells are light filters. This display device may be a high-reflective-liquid-crystal display device.

[0012]A manufacturing method of a multicolor dye sensitizing transparent semiconductor electrode memberwherein this invention is characterized by comprising the following.

A process of forming a transparent semiconductor on a transparent electrode.

A process which makes sensitizing dye of a plural color stick to two or more parts of a transparent semiconductor surface.

A process of being desorbed from sensitizing dye of a specific portion of a transparent semiconductor surface by irradiating with ultraviolet rays.

[0013]

[Embodiment of the Invention]Although the example of this invention is described in detail belowthis invention is not limited to these examples. The 1st example of this invention is described. Using the multicolor dye sensitizing type solar cell of four colors as shown in the lineblock diagram of drawing 1this example produces a light filteras shown in the sectional view of drawing 2and it makes this a liquid crystal display element.

[0014]The multicolor dye sensitizing type solar cell portion of this example like drawing 1 The 1st transparent electrode 101It becomes the

sensitizing dye adsorption parts 103, 104, 105 and 106 of four colors by which the transparent semiconductor 102 on the 1st transparent electrode 101 and the transparent semiconductor 102 were adsorbed from the carrier moving bed 107 on it and the 2nd transparent electrode 108 that counters these. The auxiliary electrode 109 is formed on the 1st transparent electrode 101 and the 2nd transparent electrode 108.

[0015] Drawing 2 is the high-reflective-liquid-crystal display device using this multicolor dye sensitizing type solar cell portion as a light filter. On the substrate 201 after laminating TFT circuits 202, the scatter reflection picture element electrode 203 and the liquid crystal layer 204 which exist for every pixel, the common electrode 205 is formed and a multicolor dye sensitizing type solar cell portion like drawing 1 is formed at the top layer. It is also possible to use the 1st transparent electrode 101 or the 2nd transparent electrode 108 as the common electrode 205 and the 1st transparent electrode 101 of drawing 1 was used as the common electrode 205 in this example.

[0016] As sensitizing dye, the cyanine yellow sensitizing dye set to $n=0$, the cyanine magenta sensitizing dye set to $n=1$ in drawing 3 and the cyanine cyanogen sensitizing dye set to $n=2$ in drawing 3 are used in the coloring matter shown in drawing 3. And what mixed cyanine yellow sensitizing dye and cyanine magenta sensitizing dye by the mole ratio of 2:1 is used as red sensitizing dye, use as green sensitizing dye what mixed cyanine yellow sensitizing dye and cyanine cyanogen sensitizing dye by the mole ratio of 3:1 and let what mixed cyanine magenta sensitizing dye and cyanine cyanogen sensitizing dye by the mole ratio of 3:2 be blue sensitizing dye. Let the coloring matter shown by drawing 4 be black sensitizing dye.

[0017] First, the manufacturing method of the multicolor dye sensitizing type solar cell portion shown in drawing 1 is described. The about 2 mol/l dissolution of the TiCl_4 is carried out into ethanol and the titanium alkoxide containing about 50mg [/ml] titanium is obtained by adding methanol. After hydrolyzing this, it applies on the 1st transparent electrode 101 that vapor-deposited platinum as the auxiliary electrode 109, it calcinates for about 30 minutes at about 400 °C and a TiO_2 film is obtained as the transparent semiconductor 102. At this time, about 600 thickness has [about 5 micrometers] preferred specific surface area when a TiO_2 film provides the unevenness to the case where the surface is a flat surface.

[0018] Next, the obtained TiO_2 film is covered with the mask which carried out the opening and only the red sensitizing dye adsorption part 103 immerses it into the ethanol solution of red sensitizing dye. After

being immersed for about 3 hours a TiO_2 film is taken out it washes by ethanol and a mask is exfoliated. Next the green sensitizing dye adsorption part 104 is immersed into the ethanol solution of green sensitizing dye using the mask which carried out the opening. After being immersed for about 3 hours a TiO_2 film is taken out it washes by ethanol and a mask is removed. Next the blue sensitizing dye adsorption part 105 is immersed in the ethanol solution of blue sensitizing dye using the mask which carried out the opening. After being immersed for about 3 hours a TiO_2 film is taken out it washes by ethanol and a mask is removed. Then it is immersed into the ethanol solution of black sensitizing dye for about 3 hours and washes by ethanol.

[0019] Besides in a layer ethylene carbonate and $\text{C}_3\text{H}_7\text{NI}$ and I_2 equimolar every The electrolysis solution which mixed the included acetonitrile so that it might become about 80% and about 20% by a volume ratio respectively The polymer beads about 10 micrometers in diameter used as a spacer are put with the 1st transparent electrode 101 that adsorbed the above-mentioned sensitizing dye and the 2nd transparent electrode 108 the side is closed by resin and a multicolor dye sensitizing type solar cell portion is obtained.

[0020] On the other hand as shown in drawing 2 TFT circuits 202 and the scatter reflection picture element electrode 203 are laminated on the substrate 201. The liquid crystal layer 204 is pinched by using the 1st transparent electrode 101 of this substrate 201 and a multicolor dye sensitizing type solar cell portion as the common electrode 205 and the high-reflective-liquid-crystal display device which uses a multicolor dye sensitizing type solar cell portion as a light filter is completed.

[0021] The place which irradiated this high-reflective-liquid-crystal display device with a multicolor dye sensitizing type solar cell with false sunlight by the intensity of about 750 mW/cm^2 When it not only can use as a high-reflective-liquid-crystal display device but it could use as a solar cell and photoelectric conversion efficiency was searched for about 6.5% of the energy conversion efficiency was acquired.

[0022] Next the 2nd example of this invention is described. Like the 1st example using the multicolor dye sensitizing type solar cell of four colors as shown in the line block diagram of drawing 1 this example produces a light filter as shown in the sectional view of drawing 5 and it makes this an electrochromic display device.

[0023] The multicolor dye sensitizing type solar cell portion of this example is constituted like drawing 1 like Example 1. In drawing 5 the same numerals are attached to the portion which is common in drawing 1 and the explanation is omitted.

[0024]Drawing 5 is the electrochromic display device using this multicolor dye sensitizing type solar cell portion as a light filter. The counterelectrode 501 is on the 1st transparent substrate 502 the electrochromic solution layer 503 the display electrode 504 which exists for every pixel and the 2nd transparent substrate 505 are laminated and an electrochromic display device part is constituted.

[0025] It is connected to the 2nd transparent substrate 505 of this electrochromic display device part and the 1st transparent electrode 101 forms the same multicolor dye sensitizing type solar cell portion as drawing 1 in the top layer. Although the 1st transparent electrode 101 was connected to the 2nd transparent substrate 505 in this example it is also possible to connect the 2nd transparent electrode 108.

[0026] Next the manufacturing method of this electrochromic display device is described. The manufacturing method of the TiO_2 film as the sensitizing dye of the multicolor dye sensitizing type solar cell portion of this example and the transparent semiconductor 102 on the 1st transparent electrode 101 is the same as that of Example 1.

[0027] Then the obtained TiO_2 film is immersed into the ethanol solution of red sensitizing dye. The back TiO_2 film made immersed for about 1 hour is taken out a mask is put on the red sensitizing dye adsorption part 103 after washing by ethanol and it irradiates with ultraviolet rays with a wavelength of about 200 nm for about 30 minutes. Then it washes by ethanol. Next it is immersed into the ethanol solution of green sensitizing dye. The back TiO_2 film made immersed for about 1 hour is taken out a mask is put on the green sensitizing dye adsorption part 104 after washing by ethanol and it irradiates with ultraviolet rays with a wavelength of about 200 nm for about 30 minutes. Then it washes by ethanol. Next it is immersed into the ethanol solution of blue sensitizing dye. The back TiO_2 film made immersed for about 1 hour is taken out a mask is put on the blue sensitizing dye adsorption part 105 after washing by ethanol and it irradiates with ultraviolet rays with a wavelength of about 200 nm for about 30 minutes. A mask is removed after that and it washes by ethanol. Next it is immersed into the ethanol solution of black sensitizing dye for about 3 hours and washes by ethanol. It produces like Example 1 and a multicolor dye sensitizing type solar cell portion is obtained.

[0028] On the 1st transparent substrate 502 that used this multicolor dye sensitizing type solar cell portion as the light filter and formed the counterelectrode 501 After laminating the electrochromic solution layer 503 the display electrode 504 and the 2nd transparent substrate 505 on it the 1st transparent electrode 101 of a multicolor dye sensitizing type

solar cell portion is connected and an electrochromic display device is completed.

[0029]The place which irradiated this electrochromic display device with a multicolor dye sensitizing type solar cell with false sunlight by the intensity of about 750 mW/cm^2 When it not only can use as an electrochromic display device but it could use as a solar cell and photoelectric conversion efficiency was searched for about 6.5% of the energy conversion efficiency was acquired.

[0030]Next the 3rd example of this invention is described. This example produces illustrated glass as shown in drawing 6 using the multicolor dye sensitizing type solar cell of two colors.

[0031]The multicolor dye sensitizing type solar cell portion of this example produces and comprises the same method as Example 1. However the pattern of sensitizing dye is made to adsorb each sensitizing dye at the pattern 601 and the background 602 using a mask unlike Example 1. In this example the red sensitizing dye of Example 1 was used for the pattern 601 and the blue sensitizing dye of Example 1 was used for the background 602. Since it does not have a portion which does not let light pass the auxiliary electrode 109 is not used.

[0032]When this illustrated glass with a multicolor dye sensitizing type solar cell was irradiated with false sunlight by the intensity of about 750 mW/cm^2 it could use as a solar cell and when photoelectric conversion efficiency was searched for about 6.5% of the energy conversion efficiency was acquired.

[0033]In the old display a part of light energy was absorbed by the light filter and it was changed into heat. However by using the multicolor dye sensitizing type solar cell of this invention as a light filter photoelectric conversion of the light energy currently changed into heat can be carried out and electric power can be supplied. As a display device such as an electrochromic display device as shown not only in a liquid crystal display element but in JP6-250233A an EL display a plasma display a display using a cathode-ray tube can also be used.

[0034]With the multicolor dye sensitizing type solar cell of this invention pattern such as a picture and a character can be allotted to glass etc. and it can also use as the window which can supply electric power a sign board a container etc.

[0035]The transparent electrode used by this invention may comprise two-layer [by which the transparent conductive layer was provided in the transparent substrate surface]. In that case as a transparent substrate there are glass a polymer film etc. and tin oxide a zinc oxide etc.

which doped fluoride indium aluminum etc. are preferred as a transparent conductive layer. Opaque metal layers such as platinum and gold in minute amount [grade / which seldom interrupts light transmission] silver copper and aluminum may be contained in the transparent conductive layer.

[0036] The anode of a multicolor dye sensitizing type solar cell and the negative electrode use the transparent electrode and constitute the transparent electrode from an example of this invention by two-layer [of a transparent substrate and a transparent conductive layer]. However as for the conductivity of the transparent conductive layer used for a transparent electrode conversion efficiency will fall well [so]. Therefore conversion efficiency can also be raised by providing an auxiliary electrode.

[0037] For example when arranging red blue and four green and black colors to a transparent semiconductor surface the black portion is effective in order for there to be almost no influence in appearance and to raise conversion efficiency even if it provides the auxiliary electrode which changes from opaque metal etc. to the black portion in order to hardly penetrate light.

[0038] When a transparent electrode is constituted from two-layer [of a transparent substrate and a transparent conductive layer] between a transparent semiconductor and a transparent electrode the position of an auxiliary electrode a negative electrode Between the transparent conductive layer in a transparent electrode and transparent substrates is preferred and when an anode constitutes an electrode surface or a transparent electrode from two-layer [of a transparent substrate and a transparent conductive layer] between a transparent conductive layer and transparent substrates is preferred in a transparent electrode.

[0039] As a material of an auxiliary electrode metals such as platinum gold silver copper and aluminum and conductive high materials such as graphite are desirable. The sensitizing dye excited by light produces an electron on a LUMO level and produces a hole on a HOMO level. The electron of the LUMO level of the sensitizing dye produced by excitation moves to the conducting zone of a transparent semiconductor promptly and is crossed to the 1st transparent electrode. Since the hole remains in the HOMO level of sensitizing dye at this time the carrier moving bed is just the material containing a carrier with the work which neutralizes this hole and an electron or a hole or ion may be sufficient as the kind of carrier.

[0040] As the carrier moving bed a liquid material or a solid material may be sufficient. As a liquid material acetonitrile / ethylene carbonate

mixed solvent electrolytic solution which comprises about 0.03 mol/l. of iodine for example with iodination tetrapropylammonium about 0.5 mol/l and potassium iodide about 0.02 mol/l may be sufficient.

[0041] As a solid material a solid ion migration material and solid hole or electronic transition material is preferred. As a solid ion migration material for example Acetonitrile and ethylene carbonate into propylene carbonate or these mixtures polyethylene oxide Polyacrylonitrile polyvinylidene fluoride polyvinyl alcohol The gel electrolyte which mixed and polymerized host polymers such as polyacrylic acid and polyacrylamide The solid electrolyte etc. which have salts such as a sulfonimide salt alkyl imidazolium salt a tetracyano quinodimethane salt a dicyano kino diimine salt in polymers side chains such as polyethylene oxide or polyethylene can also be used.

[0042] As a solid hole or an electronic transition material the organic molecule of crystallinity or amorphous nature can be used. As a thing with crystallinity electron donor acceptor complexes such as polycyclic aromaticssuch as perylene and coronene various metal-phthalocyanines and perylene tetracarboxylic acid and tetrathiafulvalene tetracyano quinodimethane etc. may be used.

[0043] As an amorphous material the aluminum quinodimethane shown by drawing 7 the diamine shown by drawing 8 the various oxadiazole shown by drawing 9 other polypyrrole poly aniline poly-N-vinyl carbazole polyphenylene vinylene etc. may be used.

[0044] Sensitizing dye will absorb incident light and will be in an excitation state an electron is passed to a transparent semiconductor and a hole is neutralized by the carrier moving bed after that. Therefore the LUMO level of sensitizing dye is the same as the conducting-zone level of a transparent semiconductor or has the necessity of being above it and the HOMO level of sensitizing dye is the same as the valence band level of the carrier moving bed or the oxidation-reduction potential of ion or needs to be below it.

[0045] It is desirable for sensitizing dye just to have an adsorption site for adsorbing to a transparent semiconductor strongly and to have functional groups such as a carboxyl group a hydroxyalkyl group a hydroxyl sulfone group a carboxy alkyl group in a molecule.

[0046] And ruthenium tris a ruthenium screw osmium tris An osmium screw type transition metal complex and a polynuclear complex a ruthenium SHISUJI Aqua bipyridyl complex It is preferred that it is the structure which had a functional group in the last paragraph in phthalocyanine dye porphyrin dye perylene coloring matter an anthraquinone pigment azo dye kino FUTARON coloring matter naphthoquinone coloring matter cyanine dye merocyanine

dyeetc.

[0047]The coloring matter which sticks to each part of a transparent semiconductor as one color may comprise one kindand in order to acquire the color for which it asksthe transparent semiconductor surface may be adsorbed in the mixture of two or more coloring matter.

[0048]**** for what colors of a color is also goodand the several colors of them do not need to contribute to photoelectric conversion as sensitizing dye. Howeverat least two or more colors in the color used need to contribute to the photoelectric conversion function as sensitizing dye.

[0049]Adsorption to the transparent semiconductor of coloring matter can be performed by immersing a transparent semiconductor into the solvent which coloring matter is dissolvingand can also heat a solvent in that case. In order to acquire the color for which it askswhen making two or more kinds of coloring matter stick to the same placethe solution of the mixture of those coloring matter may be used.

[0050]What is necessary is just to form the mask used in the control method of the place the coloring matter adsorption to the transparent semiconductor surface of this invention with the photolithographic method etc. In Example 2when carrying out decomposition removal of the coloring matter by UV irradiationthe light which focused using the lens etc.and the method of scanning a substrate top by a laser beam may be used for UV irradiation.

[0051]The material used as a transparent semiconductor is a semiconductor with little optical absorption of a light rangeIn a metal oxide semiconductorthe oxide of a transition metalfor exampletitaniuma zirconiumOxidessuch as hafniumstrontiumzincindiumyttriuma lanternvanadiumniobiumtantalumchromiummolybdenumand tungstenand these multiple oxidesor an oxide mixture is preferred. Perovskites like SrTiO_3 CaTiO_3 BaTiO_3 MgTiO_3 and SrNb_2O_6 these multiple oxides or an oxide mixtureGaNetc. may be sufficient.

[0052]As for the adsorption to the transparent semiconductor surface of sensitizing dyemore than the thickness about a number molecular layer does not take place. Thereforein order to adjust the thickness of a colordetailed unevenness can be provided in a transparent semiconductor surfaceeffectual surface area can be adjustedand the amount of adsorption per unit area of sensitizing dye can also be controlled. Particle structure can be used as rugged structure. For examplewhen producing the fine structure using the sintered compact of a TiO_2 particle with a particle diameter of about 10 nmeffectual surface area can be controlled by adjusting the thickness of a particle layer.

[0053]When making sensitizing dye stick to a transparent semiconductor coloring matter moves in the inside of the transparent semiconductor under a mask and in order to prevent coloring matter oozing out on the outside of a mask pattern in a transparent semiconductor a separator material may be included in a randomness or predetermined pattern.

[0054]

[Effect of the Invention]As mentioned above by according to the multicolor dye sensitizing type solar cell of this invention obtaining a light filter with a photoelectric conversion function and using this in a display as a driving source of a display The electric power supplied from a power supply can be reduced without providing auxiliary powers such as a solar cell in the exterior of a display and energy saving of a device can be attained. Since this light filter with a photoelectric conversion function serves as the composition of replacing the conventional light filter and it carries out photoelectric conversion of the light energy which the conventional light filter absorbed and was being changed into heat Electric power can be supplied without spoiling the luminosity and color reproduction nature of a screen compared with the conventional colored presentation panel. It can use as a window a signboard a container etc. into which information including the colored glass of a multicolor pattern a picture a character etc. with the added value of photoelectric conversion went with the multicolor dye sensitizing type solar cell of this invention.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The lineblock diagram of the multicolor dye sensitizing type solar cell of this invention.

[Drawing 2]The sectional view of a high-reflective-liquid-crystal display device using the multicolor dye sensitizing type solar cell of this invention.

[Drawing 3]The chemical formula of the sensitizing dye concerning the example of this invention.

[Drawing 4]The chemical formula of black sensitizing dye.

[Drawing 5]The sectional view of an electrochromic display device using the multicolor dye sensitizing type solar cell of this invention.

[Drawing 6]The figure explaining the illustrated glass using the multicolor dye sensitizing type solar cell of this invention.

[Drawing 7]The chemical formula of aluminum quinodimethane.

[Drawing 8]The chemical formula of diamine.

[Drawing 9]The chemical formula of various oxadiazole.

[Description of Notations]

- 101 -- The 1st transparent electrode
 - 102 -- Transparent semiconductor layer
 - 103 -- Red sensitizing dye adsorption part
 - 104 -- Green sensitizing dye adsorption part
 - 105 -- Blue sensitizing dye adsorption part
 - 106 -- Black sensitizing dye adsorption part
 - 107 -- Career moving bed
 - 108 -- The 2nd transparent electrode
 - 109 -- Auxiliary electrode
 - 201 -- Substrate
 - 202 -- TFT circuits
 - 203 -- Scatter reflection picture element electrode
 - 204 -- Liquid crystal layer
 - 205 -- Common electrode
 - 501 -- Counterelectrode
 - 502 -- The 1st transparent substrate
 - 503 -- Electrochromic solution layer
 - 504 -- Display electrode
 - 505 -- The 2nd transparent substrate
 - 601 -- Pattern
 - 602 -- Background
-